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SAN JOAQUIN RIVER MANAGEMENT PROGRAM

AN ACTION PLAN FOR

SAN JOAQUIN FALL-RUN CHINOOK SALMON POPULATIONS

Prepared for the
San Joaquin River Management Program Advisory Council
by the Fisheries Subcommittee

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AN ACTION PLAN FOR SAN JOAQUIN FALL-RUN CHINOOK SALMON POPULATIONS

A. Introduction

The San Joaquin River Management Program was established through legislation (Chapter 1068/90) to identify actions which can be taken regarding the San Joaquin River to benefit all legitimate uses of the system. The program objective is to develop comprehensive and compatible solutions to water supply, water quality, flood control, fisheries, wildlife habitat and recreation needs.

The San Joaquin River Management Program (SJRMP) Advisory Council has determined there is an immediate need for better protection of San Joaquin fall-run Chinook salmon. The last spring-run of chinook salmon in this drainage was eliminated in the late 1940's with the closure of Friant Dam. The Department of Fish and Game and the U.S. Fish and Wildlife Service have indicated that salmon populations in the Merced, Tuolumne and Stanislaus rivers are now at dangerously low levels. In the absence of immediate effective actions to improve the next few year classes they believe this stock of salmon will become likely candidates for protection under the Federal and State Endangered Species Acts. Such action would focus management decisions on protecting the fish population and habitats, with less regard for compatibility with other uses of the system.

The Department of Fish and Game has begun implementing restoration measures consistent with their "Central Valley Salmon and Steelhead Restoration and Enhancement Plan (April, 1990)." Much of their and the Department of Water Resources' effort thus far has focused on physical modification of the spawning and nursery habitats. The State Water Resources Control Board recently reconvened the Bay-Delta Hearing to develop interim standards by the end of 1992 that "help restore the environment and improve the water supply." The water supply and water quality measures in Draft Decision 1630 may improve habitat conditions for San Joaquin salmon in the tributaries and the San Joaquin Delta. Comments on this draft are due in January and a final Decision is expected in 1993. The recent Federal legislation, the Central Valley Project Improvement Act (PL-102-575), enacted on October 30, 1992, provides for opportunities to enhance the fish and wildlife resources in the San Joaquin drainage and should also be considered in relation to this Action Plan.

In recognition of the importance of immediately restoring healthy salmon production levels in concert with the other beneficial uses in the San Joaquin drainage the SJRMP Advisory Council has developed this Plan. We urge everyone involved in fishery and water-related management and planning activities that influence the San Joaquin River Basin to use this Action Plan, in combination with the plans of the responsible agencies, as a guide. We should all consider proactive implementation of the proposed action items during the next five years.

B. Purpose

The Plan identifies some key problems and provides a consensus opinion on actions recommended to measurably improve San Joaquin fall-run chinook salmon production from the low levels anticipated over the next five years. The majority of fall-run salmon return to their natal freshwater streams to spawn as two, three or four year old fish. The fate of each successive generation strongly determines how many adult fish return to produce subsequent generations. Therefore we are recommending actions to improve the fate of the one, two, three, and four year old salmon now in the ocean that will soon return to spawn, as well as the fate of their offspring over the next few years. These actions could be effective in meeting the purpose of this Plan and may help meet the legislative mandate given Fish and Game to significantly increase salmon populations by the year 2000 (ref. Fish and Game Code Section 6902 (a)). These actions should be implemented beginning in the fall of 1992 and extend through the fall of 1997. Some of the proposed actions are "studies" or planning evaluations which can provide important information leading to solutions in the future. Consistent with the charge of the San Joaquin River Management Program we recommend these actions with an eye toward protecting the other beneficial uses of the river system.

C. Life History

Chinook (or King) salmon are anadromous fish meaning they must migrate from the ocean to reproduce (spawn) in fresh water. They "home in" to their natal streams while migrating upstream and die after spawning a single time. Fall-run salmon generally start their migration from the ocean and begin arriving in the San Joaquin tributaries in early fall as water temperatures begin to cool. Most spawning occurs in the 20 river miles below the first major dams and reservoirs on the Merced, Tuolumne and Stanislaus rivers during October, November and December (Figure 1).

Females select suitable spawning sites with acceptable water depths and velocities, and gravel compositions. Nests, or redds, are excavated and the eggs are fertilized while being deposited

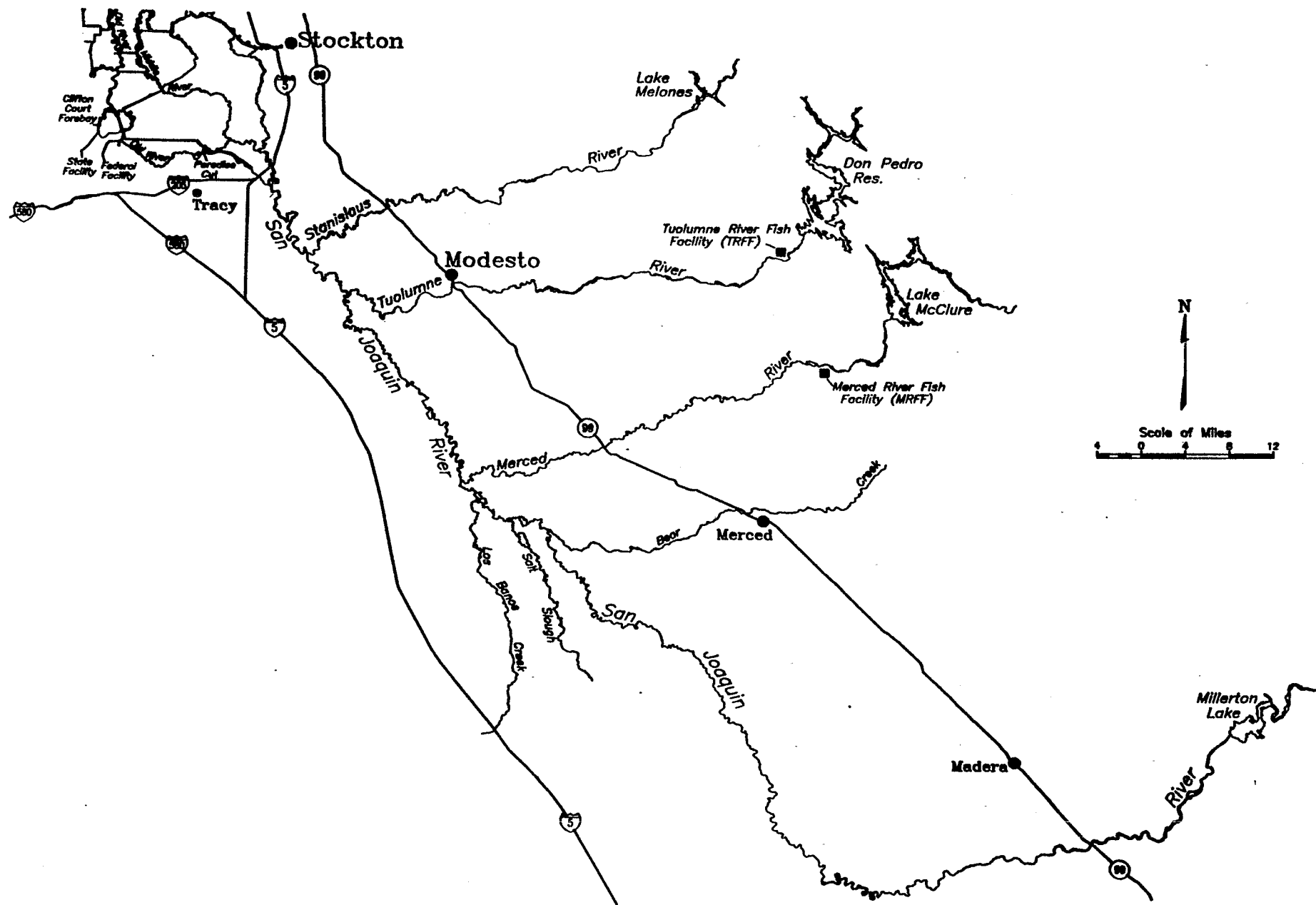


Figure 1. Map of San Joaquin River, Tributaries and South Delta

in the nest. The reproduction process generally proceeds upstream such that each successive egg pocket within a redd is covered by gravel from subsequent excavations. Generally each redd contains 2,000 to 8,000 eggs, depending on the size of the female. The adults die a few days after spawning.

Salmon eggs incubate in the gravel for approximately a month while cell division occurs. The fishery agencies recommends that incubation temperatures should be between 42 and 56°F during this time period to optimize egg survival. The sac fry or alevins then hatch and remain in the gravel, nourished by the large sack of "oil" originating from the egg. After another month the alevins have absorbed most of the oil and move up through the gravel to begin their lives as free swimming juvenile salmon in their natal rivers. They feed on plankton and insects for two to four months until reaching three to four inches in length. From mid-March through early June many juveniles undergo physiological changes, referred to as smolting, which allow them to migrate from fresh water and survive and grow to adult size in the ocean. This period of transition from fresh to salt water is very stressful for young salmon. It is believed that the homing ability which guides adult salmon back to their natal streams to spawn after two to five years in the ocean is developed as smolts migrate to the ocean. Some juveniles remain in fresh water through their first summer of life and migrate to the ocean in the fall as yearlings.

These fish become 8 to 12 pound adults within three years in the ocean. Their size and the number surviving depend on both inland (fresh water) and ocean habitat and food conditions. A substantial portion of the mortality of San Joaquin populations occurs while the young reside in fresh water. Many adults are harvested in the sport anglers and commercial salmon fishermen. As previously mentioned, most fall-run salmon in California return to spawn (or "escape" harvest and natural mortality) in their third year of life but some five year old fish return weighing up to 40 pounds. The annual population estimates (known as escapement surveys) made by the Department of Fish and Game and others document the number of returning adult fish. These are fish that have survived the fresh water environment as young, escaped the sport and commercial harvest, avoided various sources of natural or other mortality, and are returning to spawn. Generally 40 to 65 percent of the returning fish are females.

The basic habitat requirements of Chinook salmon must be met if healthy populations are to be maintained.

D. Population Status

The annual population surveys since 1953 indicate wide fluctuations in the number of salmon returning to spawn in San Joaquin River tributaries (Figure 2). The effects of drought,

Fall-Run Chinook Salmon Spawning Escapement San Joaquin Drainage

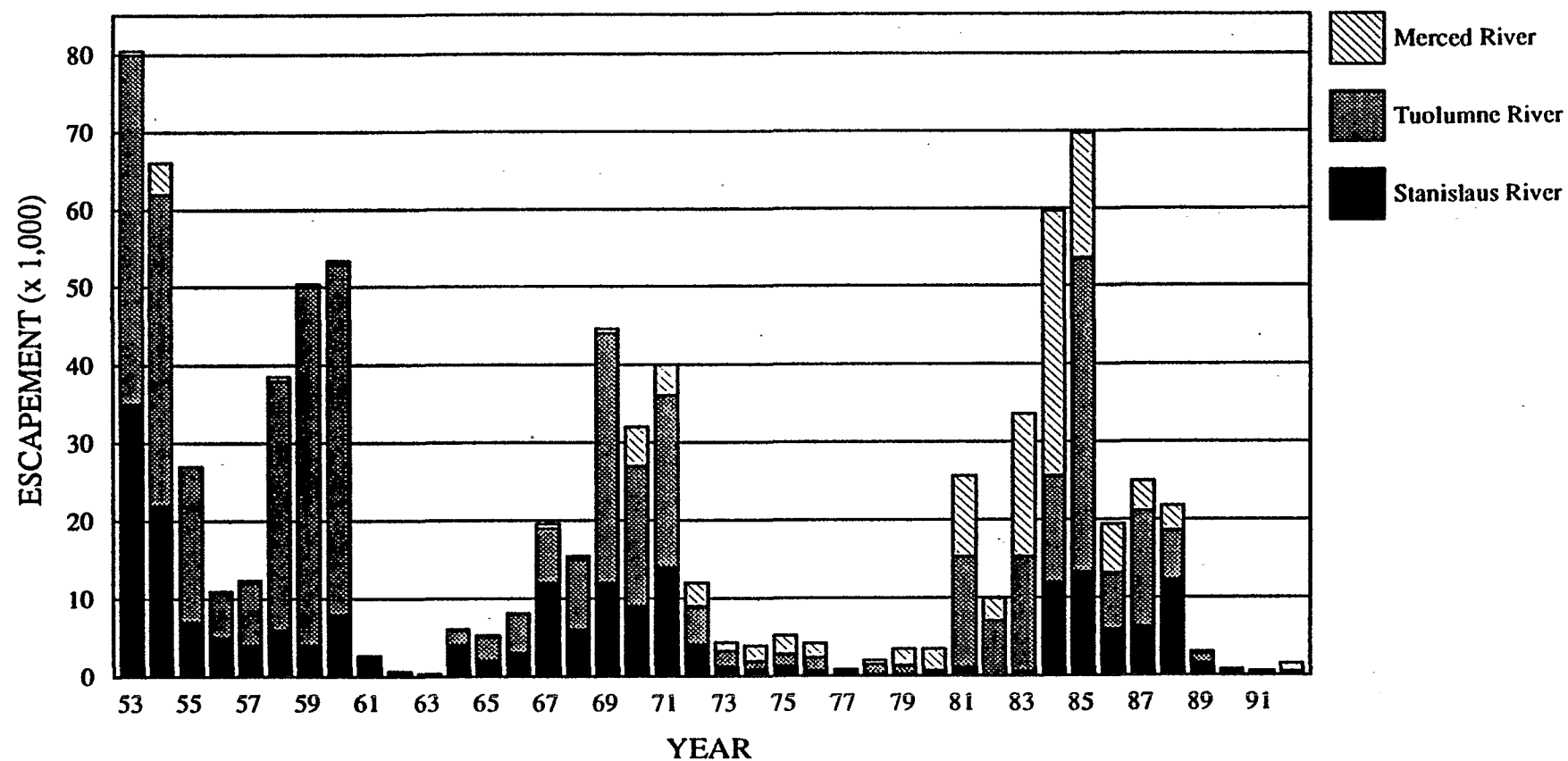


Figure 2

Source: Department of Fish and Game, Region 4
Note: 1991 and 1992 are preliminary estimates

inadequate instream flows, water developments, harvest, poor water quality, water diversions, habitat deterioration and other factors have had varying degrees of impact. The higher escapement years are strongly correlated with wet years and poor escapements correlate with normal, dry and critical water years.

Artificial propagation (hatchery production) of salmon in the San Joaquin drainage is limited to the capacities at Merced River Fish Facility (MRFF) and more recently the temporary use of the Tuolumne River Fish Facility (TRFF).

MRFF, near Snelling, was first operated in 1970 with a capacity of 250,000 yearling salmon. It was modernized in 1991 to allow incubation of up to four million salmon eggs and rearing of 600,000 smolts and 360,000 yearling salmon for release in the drainage. Production of yearlings is hampered by high summer water temperatures ($>60^{\circ}\text{F}$) and associated disease problems.

TRFF is the temporary facility developed in an abandoned section of Modesto Irrigation District's upper main canal near La Grange. The maximum capacity of this facility is unknown. Approximately one million smolts were reared there in 1989 and small groups of yearling salmon were produced in 1991 and 1992. Use of this facility is considered temporary by the Department of Fish and Game due to the physical constraints of access and the deep configuration of the old canal.

The average contribution of hatchery smolts from MRFF to subsequent San Joaquin escapements has ranged from 0 to 30 percent. Generally, yearling contribution rates to San Joaquin escapements are nearly double the rates observed for smolts.

Production at MRFF peaked in 1986 with the release of approximately 1.21 million smolts and 0.37 million yearlings. TRFF began operation in 1989 and production peaked there that year with the release of approximately 1.00 million smolts. Since 1986 the production of fish at these facilities has fallen well below capacities as the current drought continued. The 1992 production at MRFF and TRFF combined was approximately 50,000 yearlings. Hatchery contributions to the escapements in the San Joaquin drainage have averaged less than 10 percent although in low escapement years hatchery fish contribution rates are much higher, particularly on the Merced River.

The current drought (1987-1992) has resulted in very poor escapements beginning in 1990 and probably extending for five or more years. In comparison to the 16 year drought beginning in the late 1930's, or the 1976-1977 drought, the last six years have been relatively unique due primarily to the consecutive years of extremely low runoff. Water demands and use has increased since then and continued low runoff was not anticipated

by the water managers, the consumptive users, or the fish management agencies.

It is anticipated that San Joaquin tributary spawning escapements will remain near the very low levels observed in 1990 and 1991 or dwindle even further if existing environmental conditions continue. In addition to the loss of public use, these consecutively low population levels can seriously jeopardize the genetic variability of this salmon stock. Genetic attributes that help this population adapt to changes in their environment may be lost forever if a catastrophe occurs. Spawning populations in the San Joaquin drainage have fallen below 1,000 fish three times since the early 1960's (1962, 1963 and 1977). These low escapements followed previous drought periods that extended for no more than three consecutive brood years.

Salmon runs are commonly comprised of a mixture of two, three, four, and a few five year old fish. The participation of individuals from diverse age groups in each reproductive cycle is an important strategy that helps insure the maintenance of genetic variability and diversity during short sequences of low spawning runs. Since the current drought began in 1987, we have observed only the first three (1989, 1990 and 1991) of at least six consecutive spawning runs which have been strongly impacted by below normal runoff and the existing level of water development. Salmon runs into the San Joaquin drainage totaled less than 1,000 salmon in 1990 and 1991 and may not recover appreciably for four or more years without significant assistance. The rare sequence of drought years in combination with the burden of baseline pressures on San Joaquin salmon make this stock particularly vulnerable through 1996.

E. Proposed Actions

The SJRMP Advisory Council believes it is prudent for private, State and Federal water and fishery managers and others to take action to improve spawning populations and increase the survival of the offspring originating in the San Joaquin drainage. The focus of this Plan is on actions that improve the health and survival during each discrete life stage of fall-run salmon, beginning with adult fish in 1992, during the next five years.

The order of these section and action items does not imply a priority ranking; however, priority should be given to those actions which would promote naturally spawned salmon. When both natural and artificial salmon production options are feasible the preference should be given to natural production. Hatchery and other artificial substitutes for habitat may be the only means to protect and increase salmon production in some situations; and

additional hatchery production is contemplated for the longer term restoration effort.

Improving the spawning escapements of the adult fish now in the ocean, as well as the survival of their young can speed the recovery of salmon populations in the San Joaquin drainage. Recalling there are four weak year classes now in the ocean (1988, 1989, 1990 and 1991), actions that improve survival of their offspring can help build the spawning populations more quickly and help avoid further attenuation of low production levels. We have chosen to list the actions following the normal sequence of life history stages (adults, eggs, alevins, fry, etc.).

Several of these actions may be grouped into a "suite" of actions to further magnify the improvements in survival and adult production. Although this Action Plan deals with improvements in the salmon population throughout the San Joaquin drainage, it is important that each tributary must be dealt with as an individual influence to the overall plan. Subsequent efforts should include sub plans for each tributary. The objectives of these actions are (1) to obtain measurable increases in adult spawning escapements, (2) to increase the number offspring surviving the annual migration to the Pacific Ocean, and (3) to protect the stock from catastrophic loss. The responsible agencies and parties should be consulted on the priority, the groupings, and the relative merits of the proposed actions.

1. Adult salmon in ocean and inland waters Maintenance of good habitat and healthy salmon populations that support sport, commercial and other uses is a long term goal. In the San Joaquin drainage it appears most important to increase the number of offspring produced from the next five generations (1992, 1993, 1994, 1995 and 1996). Legal and illegal harvest removes a significant number of adult male and female salmon from the population prior to spawning. The following measures have potential to increase the number of age three, four or five adult salmon that survive to successfully spawn in the San Joaquin tributaries:

- a. Evaluate the costs, benefits and practicality of a marking program for hatchery origin salmon with an identifiable external mark to provide greater protection of naturally produced salmon and selective harvest of hatchery fish by sport and commercial anglers. The mortality rate of sub-legal fish caught and released in the ocean fisheries is thought to range from 12 to 30 percent. Definitive information does not exist. This mortality factor can strongly influence the net benefit of a complete marking program for hatchery stocks. Therefore, it is

Adult salmon... Continued

important to define the actual rate of "shaker mortality" prior to a decision on a complete marking program.

Currently the adipose fins are removed from all young salmon receiving coded-wire nose tags. Most of these fish are of hatchery origin. This external mark remains on the fish throughout its life and is readily discernable by biologists and fishermen. If another reliable external mark were available it may provide an opportunity to protect weaker stocks and naturally produced fish through selective harvest regulations. This may be established in certain zones and may not require that all hatchery fish be marked. Literally millions of young salmon are produced each year at seven major fish hatcheries and many fish facilities and pond rearing sites in California alone. To be effective along the entire coast of California this program may also need to be implemented in Oregon and Washington. The evaluation of this program should consider biological issues, cost, and the time period before any benefits may be perceived.

- b. Request the California Fish and Game Commission to establish a zero salmon limit in the San Joaquin drainage from River Mile zero near Chipps Island upstream to the first major dams on all spawning tributaries south of Stockton.

Current regulations protect San Joaquin salmon only after they have migrated upstream of Interstate Highway 5 Bridge near Mossdale Crossing. Angling in the Delta during the fall and winter migration months can harvest adult salmon destined for the San Joaquin tributaries.

- c. Evaluate ocean distributions and other information for San Joaquin fall-run relative to other fall-run stock, and the procedures for modifying the Pacific Fisheries Management Council Framework Plan that defines current fish management policies and ocean regulations.

Currently the Framework Plan provides for ocean management of all Central Valley fall-run stock as a single unit with a spawning escapement goal in the Sacramento River of 122,000 to 180,000 hatchery and natural adult salmon combined. In addition, the ocean management strategy seeks to (a) limit the harvest of Klamath River fall-run chinook, and (b) to limit the impacts on Sacramento winter-run chinook salmon to a level no greater than occurred in 1990. The Director

Adult salmon... Continued

of the Department of Fish and Game makes annual harvest recommendations for California fisheries to the Pacific Fisheries Management Council. The California Fish and Game Commission typically adopts regulations for the zero to three mile zone along the coast that are consistent with those adopted by the Council (affecting the area 3 to 200 miles off the coast).

Under the current Framework Plan the harvest of San Joaquin fall-run stock (the weaker stock) in the ocean is managed based on the status of the Sacramento River stock. Significant hatchery contributions help maintain the Sacramento River runs within the Framework Plan goal. Under this scenario the San Joaquin runs can be very low but if the Sacramento River runs fall within the goal no further protective action in the ocean is taken. This "surrogate" protection for San Joaquin stocks in Federal and State jurisdiction waters (0 to 200 miles off the coast) may not provide adequate protection in the ocean to ensure adequate spawning escapements, particularly during extended periods of below normal or drier runoff. This action item proposes that responsible agencies (1) review existing biological information and (2) implement the two-year amendment procedures for modifying the Framework Plan to protect San Joaquin stock separately if feasible alternatives are available. Such changes should ensure that over-escapement does not occur in the Sacramento River, and that sport and commercial fisheries are not closed in lieu of more significant actions more likely to improve escapements.

- d. Law enforcement effort should be elevated during October through December to curb poaching losses in the designated salmon spawning areas of the San Joaquin drainage.

The Department of Fish and Game is reviewing planned work schedules of adjoining unit staff and has recently filled the Modesto Warden position. Six new Warden positions have been established in the Delta through the use of mitigation funds and additional effort in the Old River and Middle River area may be helpful if Action Item 1.b. is implemented. Despite budget constraints a priority should be placed on protection of spawning runs and habitats through 1996. A debriefing at the end of each season should be completed to make necessary refinements.

Adult salmon... Continued

- e. Recognizing the limits of existing funding and staffing, agencies involved should pursue options for redirection or additional staffing, operating and overtime funding to increase law enforcement efforts in the spawning area from late October through December during each of the next five years.

Similar to the expanded enforcement effort in the Delta to reduce poaching losses, funding from the Delta Pumps Fish Protection Agreement or other sources could be pursued to increase enforcement effort on the San Joaquin spawning and nursery areas. A range of options including overtime funds and additional personnel should be considered.

- f. Responsible agencies could develop an information document requesting voluntary assistance of the various constituent groups in activating Stream-Watch networks.

Pertinent information on reporting violations, the population status and the activities underway to restore San Joaquin drainage runs could be dispersed. Sportsmen clubs and landowners have developed Fisheries Watch Networks to help protect habitats and fisheries in their area. A public relations effort to increase the involvement of these groups could be very helpful.

- g. Increase the incentives for reporting violations.

Clubs should be encouraged to make CalTIP contributions as conservation projects to stimulate reporting and improve the effectiveness of protecting salmon in the spawning areas. County Fine Committees may also provide funding for this purpose. A bumper sticker campaign may help encourage participation.

- h. Explain the importance of protecting fall-run salmon in the San Joaquin drainage.

Joint press releases by participating parties, public relations articles in the San Joaquin Valley newspapers, Outdoor California, Western Water, agricultural newsletters or other publications could be helpful and many people would be interested. Descriptions of the voluntary actions taken by the SJRMP participants to restore this salmon stock should be published and widely distributed. Discussions on public radio and television stations could be beneficial.

Adult salmon... Continued

This action item not only increases the base of understanding in the local and not-so-local areas but also provides an excellent public relations opportunity for those entities participating in the various action items. Greater public support may be the key to decisions on contentious action items. Thus, effective public relations may be a necessary precursor to implementing other action items.

2. Upstream migration of adult salmon Low dissolved oxygen, high water temperatures and a lack of attraction flows of San Joaquin River drainage origin appear to cause blockage or delays and straying during fall migrations upstream. The following actions have the potential to stimulate more timely and successful upstream migrations of adult salmon to their natal spawning areas:

- a. Improve instream flows in the Merced, Tuolumne and Stanislaus and San Joaquin rivers.

Voluntary land fallowing programs, efficiency improvements, temporary water sales, purchase of water rights or lands with water rights, exchanges/transfers through the use of the State Water Bank or other arrangements, and implementation of the recent Tuolumne River Agreement should all be considered as alternatives to augment instream flows.

Water Bank sales on the Stanislaus (50 TAF) and Merced rivers (15 TAF) were performed in 1992. Interim benefits to instream uses in these river and the San Joaquin River can occur when economic incentives for water right holders are available. There appear to be many innovative ways to improve instream flows on an interim basis. Responsible agencies and water right holders could proactively pursue such measures, consistent with the Governor's Water Policy. The U.S. Bureau of Reclamation's Friant EIS, the San Joaquin River Basin Resources Management Initiative, CVP reform legislation or other federal actions may also lead to improvements in instream flows.

Accelerating planning studies for additional offstream storage and conjunctive use programs with emphasis on improvement of salmon habitat could be encouraged. Efforts underway by the U.S. Bureau of Reclamation on Montgomery Reservoir in the Merced River drainage is one example.

Upstream migration... Continued

- b. Develop and implement measures that provide adequate water temperature within the designated spawning areas by mid-October each year.

It is the position of the fishery management agencies that optimum spawning and incubation temperature where no salmon egg mortality occurs (due to temperature alone) is between 42-56°F. While there is agreement that salmon do have certain temperature tolerances and that the egg stage is probably the most sensitive a few parties continue to express reservations with (1) the basis for this recommendations, (2) whether these recommendations will become hard goals or just objectives to strive for, and (3) whether reservoir releases for temperature protection purposes would be subject to some test of reasonableness. All of these concerns are issues to be determined through more formal administrative and sometimes legal processes and are beyond the scope of this Plan. The Regional Water Quality Control Board or the State Water Resources Control Board may provide appropriate forums for resolution.

In the interim a temperature objective of 42-56°F should be used as a target throughout the designated spawning reach on each tributary. Special water operations using this objective were implemented on the Stanislaus River in 1991 and 1992 with the cooperation of the U.S. Bureau of Reclamation, Oakdale and South San Joaquin Irrigation Districts and the Tri-Dam Project. Responsible parties should explore and accelerate options for structural, operational, and other actions (e.g., riparian vegetation restoration to increase shading) to make water temperature improvements in the spawning, nursery, and migration reaches in the drainage.

- c. Install the upper Old River Barrier each fall to improve guidance flows and water quality for fish migrating upstream through the San Joaquin Delta.

The installation of this barrier in the fall by the Department of Water Resource has been used to improve habitat conditions for upstream migrants when necessary. Rip-rap is placed in the head of Old River to increase the proportion flow that continues down the San Joaquin River to the Stockton Turning Basin area. Low dissolved oxygen has persisted there in dryer years despite reductions in cannery wastes and tertiary treatment of Stockton waste water. This fall barrier at Old River continues to be the primary measure used to alleviate the

Upstream migration... Continued

dissolved oxygen "sag" which can block adult salmon migrations at concentrations less than 5.0 parts per million. Stockton is proceeding with water quality and wastewater reclamation studies which may eventually result in eliminating a portion of their discharge to the San Joaquin River. Dissolved oxygen levels of 2.0 parts per million or less were recorded near Stockton in October, 1992 during the normal salmon migration period. An interim solution is sorely needed.

The Central Valley Regional Water Quality Control Board feels that ammonia levels in the Stockton area are a potential problem. Further study is needed to determine whether there are any negative impacts on salmon migrations.

With improved Delta modelling capabilities and detailed water quality information it is possible that a model could be built, validated and calibrated to assist in selection of better management options to avoid or mitigate this problem. The combination of a complete barrier at Old River, operation of the aeration device at Rough and Ready Island, and additional streamflows (ref. Vernalis) should be evaluated for use in dry or critical years to increase attraction flows and help reduce the dissolved oxygen "sag" near Stockton. Tidal stage and both State and Federal water project operations also influence this area.

All features of the 1969 Four Agency Memorandum of Understanding (MOU) could be implemented to remedy the dissolved oxygen problems in the lower San Joaquin River until such time as the above studies result in a more effective solution, or until the State Water Resources Control Board issues Interim or New Delta standards or objectives that remedy the problem. The 1969 MOU provides for the release of up to 60,000 acre feet additional Federal water supplies upstream of Vernalis to help improve the dissolved oxygen near Stockton if the problem is not resolved by the installation of the upper Old River barrier by Department of Water Resources.

- d. Evaluate and establish conditions on dredging of the Stockton Turning Basin that help avoid dissolved oxygen levels below 6.0 parts per million during salmon migration periods.

Late summer dredging activities in 1992 appear to have exacerbated the dissolved oxygen "sag" in the San

Upstream migration... Continued

Joaquin River near Stockton this fall. There are many other factors which influence oxygen levels in this area of the Delta. Changing the time period of acceptable for dredging may help insure free passage of adult salmon en route to spawning areas.

- e. Create adequate fall attraction flows from each tributary.

Scheduling of existing fishery water supplies and conjunctive use of other supplies should be considered to improve the attraction flows to guide salmon to their natal spawning areas. Typically, upstream migration occurs in October, November, and December.

Inter-basin water use options should be explored to provide better attraction flows without increasing the problem of fish straying into inappropriate areas in the drainage.

- f. Monitor and, if necessary, recommend expansion of the water hyacinth control efforts into other parts of the drainage.

California Department of Boating and Waterways (CDBW) and County Agricultural Commissioner currently cooperate on the control efforts in Merced County. CDBW operates a larger program in the Delta and a minimal program elsewhere in the San Joaquin drainage. If the drought continues and dispersal of this plant becomes a problem it may be beneficial to expand the control effort.

- g. Install and evaluate a temporary electrical or physical migration barrier in combination with greater attraction flows from the Merced River.

For many years guidance flows from the Merced River have been inadequate during October. Many salmon have strayed into agricultural drainage flows returning to the San Joaquin River, primarily from Mud and Salt sloughs. A barrier (electrical and physical) across the San Joaquin River upstream of the Merced River confluence has been installed in 1992 and should be evaluated under various streamflow conditions. The objective is to prevent salmon migration into sloughs where their offspring will be lost, and to help guide them into the Merced River. A substantial budget will be necessary for construction, operation and maintenance if this pilot facility is effective.

Upstream migration... Continued

- h. Trap and spawn adult salmon at various locations in the drainage.

If the drought continues and other measures to improve spawning and recruitment of natural fish fail, more aggressive fish cultural efforts may be warranted. Trapping on the San Joaquin River in 1977 and at Los Banos Wildlife Area from 1988 through 1991 exemplify situations where habitat conditions were poor and no other options to sustain natural production was available. Funding through the Commercial Salmon Stamp Program and Drought Relief funding have supported such emergency programs in the drainage since 1988. Alternative funding may be appropriate.

- i. Evaluate tri-annual amendments to the Regional Water Quality Control Board's Basin 5C Plan for adequate protection of cold water beneficial uses in the San Joaquin drainage.

The current Basin 5C Plan provides very limited protection for the designated cold water beneficial uses. The Regional Board attempted to deal with a very similar situation in the Sacramento River in 1988 through a waste discharge requirement order. The State Water Resources Control Board determined that the issue should be addressed through its water rights authority. The time for this process may exceed the duration of this Plan. However, as a minimum the Regional Board's Plan could be revised to clearly designate the locations and time periods crucial to the reproductive success and rearing of Chinook salmon in Basin 5C.

Studies to more clearly define temperature requirements could be implemented. Different life stages may have different temperatures tolerances depending on the combination of acclimation temperatures, exposure times and the actual temperature, and other factors. It is unlikely that such studies could be completed within the time frame of this Plan. Therefore an interim temperature objective for each life stage may be appropriate (See 2.b. above).

- 3. Spawning, egg incubation, emergence and juvenile rearing High water temperatures, poor or no screens on water diversions, poor spawning habitat quality, high predation rates, and inadequate instream flows (including channel maintenance flows) are believed to be the primary factors causing mortalities during these life stages. Remote trapping and spawning operations to increase

Spawning, egg, and juveniles... Continued

hatchery production levels have been marginally effective in overcoming some of these mortality factors. Planning studies for additional offstream storage and new hatchery facilities have been initiated but will not be completed within the time frame of this Plan. The following actions have potential to increase the number of juvenile salmon produced from the next five generations which survive to the next life stage:

- a. Develop and implement measures to maintain water temperatures in the spawning reaches at adequate levels October 15 through mid-March and for juvenile rearing reaches particularly in April and May.

See Actions 2.b. and 2.i.

- b. Develop additional instream flows to augment existing schedules.

See Actions 2.a. and 2.c. above.

- c. Produce an acceptable number of hatchery yearling salmon when trapping and hatchery programs are used.

Similar to Action 2.h. this action includes the trapping of adults to obtain eggs for hatchery programs, or the recovery of naturally produced salmon (fry, juveniles and smolts) which are then maintained in a hatchery. A variety of products (sizes of fish) are produced in hatcheries to be released back into the wild. Examples are smolts (70-90/lb juveniles) or yearlings (6-10/lb juveniles). Yearlings remain in the hatchery longer, are larger at release, and because they migrate to the ocean and reach legal size later they generally avoid some of the natural and harvest mortality. The result is a greater contribution to escapements than fish released as smolts. Yearlings have a slightly greater tendency to return to spawn as two year olds resulting in less recruitment to subsequent generations. All considered, doubling the contribution rate of hatchery products to escapements by using yearlings the next few years may be a useful measure to speed recovery of adult salmon numbers.

- d. Increase survival-to-emergence and improve rearing habitats.

Accelerate planning and construction of priority habitat improvement projects in the spawning and nursery areas. More than \$1 million has been expended on habitat improvement project on spawning tributaries

Spawning, egg, and juveniles... Continued

in the San Joaquin drainage since 1988. Funding has been secured for Department of Water Resources to design ten additional projects over the next few years and funding for construction is available through the Delta Pumping Plant Protection Agreement. Funding for additional habitat work is available from other State and Federal sources. It should be recognized that although these projects can provide incremental benefits in the short term the full potential of habitat improvement efforts cannot be met until (1) the spawning escapements recover to the point where habitats (spawning and nursery) can be fully "seeded" each year, and (2) adequate streamflows and protection from diversions are in place.

e. Reduce predation mortality.

Encourage harvest of un-naturally high concentrations of predators from the spawning and rearing reaches.

Feasible control efforts could be pursued where un-naturally high predator densities exist. Recently the Merced Fly Fishing Club assisted the Department of Fish and Game in removing non-game fish from the Merced River salmon spawning area. Fish removed were utilized by the local Southeast Asian Community. Efforts such as these provide only minor temporary benefits but may help. Improvements in habitat and streamflow conditions that favor cold water species instead of predators will be most effective in the long term. Actions 2.a., 2.b., 2.i., 3.a., and 3.b. all provide opportunities to help reduce predation mortality in this manner.

Low summer flows tend to encourage larger predator populations which are then present when young salmon emerge and rear. Actions that increase cold water habitat conditions through the summer months in the nursery reaches may be beneficial.

Artificial structures or features that concentrate predators could be eliminated where possible. Dennett Dam on the Tuolumne River, old bridge footings and piers, irrigation diversion structures (e.g., pilings to support pumps) all tend to concentrate predators.

Old gravel pits in the river channel support significant predator populations. Habitat improvement projects under Action 3.d. can result in reduced

Spawning, egg, and juveniles... Continued

predation mortality as well as improved rearing habitat and water quality (e.g., temperature).

- f. Evaluate and encourage conjunctive benefits of domestic water supply projects.

State and Federal grant, loan and mitigation programs and other incentives could encourage domestic water supply projects to utilize the natural channels (salmon spawning and rearing reaches of the San Joaquin tributaries) as the primary conveyance channels. Domestic water supply projects may provide opportunities to benefit multiple uses without significant additional cost. Water quality, quantity and cost-benefit are important factors to consider on a case-by-case basis.

This Action would provide complementary benefits to many other Actions listed in this Plan.

- g. Accelerate evaluations of the impact of different types of diversions (e.g., siphons, pumps, etc.), and install protective devices (e.g., screens, electrical fields, etc.) on priority agricultural or other diversions within the nursery and migration reaches.

The Department of Fish and Game and the Department of Water Resources have study programs underway to determine fish losses associated with various types of diversions. These studies should be evaluated to ensure that the results will be directly applicable to the types of diversion impacts occurring in the San Joaquin drainage. A quick review of water rights and points of diversions along the 50-plus river miles on each tributary indicates that many diversions in the primary nursery areas are made by small pumps. The main exceptions are on the Merced River where riparian water is diverted by gravity flow into screened ditches.

Larger diversions (up to 250 cfs) occur along the main San Joaquin River where rearing generally occurs only in wet and above normal years when flows are high, water temperatures are cool and fry are dispersed well downstream. Screening to protect outmigrating smolts is addressed in Action 4.

Fish screens or other protective devices could be installed on priority diversions as screening technologies are identified, and the funding

Spawning, egg, and juveniles... Continued

responsibilities to install, operate and maintain them are defined. Installation without commitment for maintenance should be avoided.

- h. Accelerate planning studies for additional offstream storage and conjunctive use programs which benefit protection of salmon habitats.

The benefits of this effort may not be attainable within the time period of this Plan. However, these studies can improve our understanding of the opportunities using existing project features and help foster proactive problem solving.

See Action 2.a.

- i. Continue planning and design studies for hatchery supplementation of natural salmon populations.

Use of the Tuolumne River Rearing Facility (Modesto I.D. abandoned main canal section near La Grange) and Merced River Fish Facility should continue while planning for additional supplementation proceeds. Although these existing facilities have not been operated to capacity for some time due to the low abundance of eggs, history tells us that this stock can rebound quickly. If appropriate planning and environmental analysis proceed over the next five years, additional supplementation capabilities could be available when the populations rebound from their current depressed status. Thereafter supplementation in combination with improved habitat and instream flows could help avoid serious depression in future droughts.

4. Smolt and yearling outmigrations High mortality during outmigrations is believed to be caused by high predation rates, low streamflows, high water temperatures, poor or no screens on water diversions, flow reversal and high export rates in the Delta and other factors. Losses occur in the nursery tributaries, along the mainstem San Joaquin River above Vernalis, and in the Delta. Again, a suite of actions that improves survival in each segment of the outmigration route will likely provide the greatest benefit. The following Actions have potential to increase the number of San Joaquin salmon smolts safely reaching the Pacific Ocean:

- a. Augment existing instream flows in the nursery tributaries in April and May.

Smolt and yearling outmigrations... Continued

Migration studies indicate that smolts leave the San Joaquin tributaries en route to the ocean in April and May of drier water years. Survival studies suggest that significant mortality occurs in the tributaries, before reaching the Delta, under existing streamflow schedules.

See Action 2.a.

- b. Augment April and May flow at Vernalis and into the South Delta.

Once smolts reach the San Joaquin River movement rates slow and exposure to predation, high water temperature and other factors increases. A basin-wide water scheduling approach is needed to obtain tributary streamflow contributions at the proper times and amounts to speed outmigration and optimize the survival benefits to salmon. The "controlled freshet" evaluation proposed by the Department of Fish and Game in the recent State Water Resources Control Board Hearings could be beneficial.

See Actions 2.a.

- c. Operate the State and Federal Water Projects in a manner that provides a positive San Joaquin River flow downstream through the San Joaquin Delta in April and May.

In the South Delta smolt mortality is high until they have migrated beyond the influence (direct and indirect) of the State and Federal water export facilities. Generally a net downstream flow increases the survival rates through the area of high mortality. Early study results suggest that survival may increase significantly once migrating San Joaquin smolts reach the mouth of the Mokelumne River. Operational changes at the State and Federal facilities, linking Delta exports with Vernalis flows to create a net downstream flow while San Joaquin smolts are actively migrating, may greatly improve survival. Combining this action with "controlled freshets," improved screening, and a complete barrier in upper Old River further may improve the likelihood of significant survival benefits. The State Water Resource Control Board's Draft Decision 1630 acknowledges these concepts and may put in place the hydraulic conditions and a monitoring effort to evaluate the benefits of such a program.

Smolt and yearling outmigrations... Continued

- d. Install fish protective devices on agricultural or other diversions in the San Joaquin River and South Delta.

The delays associated with major capital outlay for large new screens may be avoided if temporary fish screening technologies are used. Some diversions may have a greater probability to impact migrating salmon and this may change each year depending on the distribution of spawning in the tributaries. Temporary screens or electrical/sound devices that provide significant benefits may ultimately lead to permanent facilities. Other diversion have existing screens that could be repaired or modified to provide improved screening efficiency. If screening (or treating) additional diversions proves effective, and the ability to fund and maintain these devices increases, proceed with plans for permanent facilities where appropriate.

Accelerate upgrading or refurbishing existing devices. Define construction, operation and maintenance responsibilities. Monitor efficacy and schedule further improvements.

See Action 3.g.

- e. Evaluate the use of alternative water supplies for riparian diversions during April and May.

Riparian diversion from the lower San Joaquin River can remove 25 to 60 percent of the total river volume during low flow periods. Due to low instream flow allocations from the tributaries the mainstem flows are generally low and riparian water demand is high during the April-May migration period. Alternative water supplies (e.g., CVP delivery from the Delta Mendota Canal) during this short period each spring may reduce the need for a fish protective device while increasing the streamflow into the Delta.

- f. Develop and implement actions that maintain acceptable water quality in the nursery tributaries and the lower San Joaquin River during the April-May outmigration period.

Specific temperature criteria for this life stage may need further definition through field and laboratory studies depending on the outcome of the State Water Resources Control Board's Bay-Delta Hearing process.

Smolt and yearling outmigrations... Continued

Implementation of streamflow improvement actions may help reduce exposure to temperature impacts and influence acclimation and temperature gradients.

The existing temperature models on the Tuolumne and Stanislaus rivers may prove useful in assessing the benefits of various operational measures to reduce water temperature.

Evaluation of minimum storage pools and the potential benefits of multi-elevation outlets in the large reservoirs upstream of the designated spawning areas should be completed.

The addition of a new offstream storage reservoir in the Merced River drainage (e.g., Montgomery Reservoir) managed in concert with the existing reservoirs may increase the amount of cool water available for instream fishery use.

Central Valley Regional Water Quality Control Board studies have indicated that there is periodic toxicity in the east side tributaries and the San Joaquin River during winter and spring months. The pesticide levels are toxic to invertebrates which may affect the availability of food or the overall health of young salmon.

Researchers at the Dixon Field Station of the National Fisheries Contaminant Research Center performed a survey of trace element accumulation and toxicity of agricultural drainage water co-mingled with San Joaquin River water. Their results indicated that the elevated concentrations, and perhaps combinations, of trace elements and ions (e.g., Na_2SO_4 - sodium sulfate) associated with some San Joaquin Valley agricultural drainage water may reduce juvenile salmon growth and increase mortality.

See Actions 2.b., 2.i., and 3.a. for the egg and juvenile life stages.

- g. Evaluate and install a complete barrier at the head of Old River from April 1 through May 31 each year, in conjunction with other South Delta water quality barriers, and monitor its effectiveness.

Studies to date indicate that significant improvements in survival may accrue if smolts migrate down the San Joaquin River past Stockton, avoiding direct diversion

Smolt and yearling outmigrations... Continued

to the State and Federal export facilities. A detailed evaluation of a complete barrier in Old River is underway as part of the Temporary Barriers Project. Evaluation of the benefits (reduced direct and indirect mortality) of this barrier under a full range of Vernalis streamflow and water export conditions should be completed as soon as possible, and before the final decision to construct and operate a permanent barrier. Much of this work may be completed as part of the South Delta Water Management Project.

- h. Use operational criteria that optimize screening efficiencies (e.g., approach velocities) for salmon at the State and Federal water export facilities during San Joaquin smolt outmigrations.

Evaluations of screen efficiencies have determined the ranges of optimum approach velocities and other criteria for the principle species encountered at the export facilities. Unfortunately the criteria are not the same for all species and there is overlap in their temporal recovery patterns. Therefore decisions on operating criteria must be made. We encourage the operators to utilize the optimum criteria that effectively screen and salvage chinook salmon throughout the months of April and May during the next five years.

- i. Evaluate upgrading existing fish screening facilities and accelerate planning to implement changes.

This is an ongoing process at the State facility and the recent mitigation agreement to offset direct losses at the Federal facility may result in a similar emphasis on upgrading.

- j. Reduce predation losses at Clifton Court Forebay and at Tracy Pumping Plant.

Department of Water Resources and Department of Fish and Game are discussing an evaluation of diverting SWP supplies from Italian Slough instead of Clifton Court Forebay as a possible way to reduce predation losses. Conceptually the large body of water in the forebay would not be present to support the large standing crop of predators thought to be causing high salmon mortality. This Action item may be implemented within the time frame of this Plan and the information developed in the evaluations will be of utility.

Smolt and yearling outmigrations... Continued

Beach seining and other measures to reduce predator density are being evaluated at Clifton Court Forebay.

Regular removal of striped bass from the secondary screen channels at the Tracy Facility should continue until a more permanent solution is found.

- k. Reduce indirect smolt mortality caused by the State and Federal Water Projects in the San Joaquin Delta.

Mitigation agreements are now in place to offset the direct loss of some fish species and the State and Federal water export facilities. Negotiations between Department of Water Resources and Department of Fish and Game have been underway for some time in an attempt to mitigate the indirect losses associated with the State project operations. Recently negotiations (South Delta Water Management Alternatives Project and Article VII of the Delta Pumping Plant Agreement) have accelerated. Resolution of the various project-related problems may be beyond the scope and time frame of this Plan. However, SJRMP Advisory Council encourages the parties to evaluate and implement interim mitigation features that rely on "real-time" knowledge of fish movements, guidance structures (e.g., Old River Barrier) and coordinated basin-wide water operations (Delta and tributaries) to reduce the indirect impacts of these projects on-site if at all possible.

- l. Evaluate "trap and truck" or other measures to avoid high mortality of salmon juveniles and smolts.

This approach has not been used extensively in California. Research on the Columbia River system dating back to the 1970's suggests that there may be value in this approach for smolts. It requires substantial capital and staffing. Department of Fish and Game has trapped newly emergent fry and successfully reared them at the Merced and Tuolumne River rearing facilities in the past. This has been a small scale operation thus far. The concept is to recover young fish at a time or location before major mortality occurs and to transport or in some way release the salvaged fish back into the system in a manner that results in increased production of adult fish. There may be merit in exploring this action item if most others fail.

5. Genetic maintenance The homing behavior of Pacific salmon and the late migrations of fall-run salmon into the San Joaquin drainage tend to restrict gene flow between other fall-runs in the Central Valley. Balancing this geographic and temporal separation is the natural tendency for salmon to stray. Genetic studies in California suggest that there is high gene flow between salmon populations in the Central Valley. Some believe this may be a symptom resulting from the transportation of large numbers of hatchery fish from the Sacramento River drainage downstream to the estuary resulting in higher straying rates when these fish return.

Very few tagged fish from hatcheries in the Sacramento River system have been recovered during spawning escapement surveys in the San Joaquin drainage. This may be due to significant differences in water quality and the difference in timing of upstream migrations. Also, there has been very limited transplanting of eggs and young salmon into the San Joaquin drainage from non-natal streams. In the late 1960's eyed salmon eggs from the American River were buried in the spawning gravels two years, and sac-fry (alevins) were released into the San Joaquin tributaries only one year. Due to the sensitivity of these early life stages and the lack of response in subsequent runs, it does not appear these plants produced many adult fish.

The genetic research work completed to date identified that (1) coastal and Central Valley Chinook salmon in California appear to be genetically differentiated by drainage and river system (allozyme analysis), (2) there is a high level of gene flow between Central Valley salmon runs, (3) although gene flow between populations may be high they may still be differentiated (by measures such as genetic distances, allele frequencies, unique alleles, etc.), and (4) monitoring and preservation of the variability and diversity of existing genetic resources should be strongly encouraged.

The following actions, and probably combinations of these, should be considered for inclusion into existing and future management activities in the San Joaquin drainage:

- a. Use a "gene bank" (cryogenic preservation) to ensure the protection of San Joaquin fall-run salmon genetic material in the event of a catastrophic loss.

We are relatively unfamiliar with this technique but recognize that it has been used to preserve Atlantic salmon genetic material. It probably warrants a thorough review in advance of catastrophic losses.

- b. Selective harvest of hatchery fish.

Refer to 1.c. above.

Genetic maintenance... Continued

- c. Use natural fish in captive breeding programs.

Monitor the Winter-run program now underway at Bodega Bay Marine Laboratory and the Steinhardt Aquarium where young fish will be held in captivity until reaching adulthood to become captive broodstock. There are a number of other approaches that rely on either hatchery or wild gametes or juveniles reared in ocean net pens or isolated fresh water facilities, which are then brought back to their natal stream so their offspring imprint on their natal drainage. There are steelhead enthusiasts and people interested in restoring native runs who have adopted similar programs making them appear fairly cost effective. Again we are relatively unfamiliar with the results and recommend a thorough review before adopting this as a primary strategy.

- d. Complete genetic differentiation studies in the San Joaquin tributaries and monitor appropriate indicators through time to help preserve genetic variability and diversity.

Research completed to date does not conclusively separate, nor does it combine, the San Joaquin fall-run with runs elsewhere in the Central Valley. Genetically these fish were most closely grouped with the fall-runs in the American and Feather Rivers (dendrograms). The Department of Fish and Game has continued to manage the stock as a discrete unit from stocks outside the drainage.

Due to the long history of trapping and outplanting young from within the San Joaquin drainage and then planting the offspring in all three tributaries, unique genetics between fish from the three tributaries seems unlikely. Genetic evaluations using mitochondrial DNA polymer chain reaction products for electrophoretic analysis are underway elsewhere in California and may be quite valuable in this drainage. This and other techniques could be used to determine if San Joaquin stock may be differentiated from other fall-runs in the Central Valley. They have been differentiated from fall-runs in the north coast rivers.

- e. Establish a genetic advisory committee using the knowledge and resources of academia and management experts.

Current research results and management techniques useful in developing genetic maintenance strategies

Genetic maintenance... Continued

should be monitored on a regular basis. An Advisory Committee could (a) review the impacts of hatchery release strategies, (b) examine operations at Merced River Fish Facility and associated operations, (c) identify fish culture techniques influencing the genetic make-up, (d) propose possible mating strategies to minimize the potential effect of crossing limited adults. In combination these efforts could help insure the San Joaquin stock can adapt to future habitat changes and continue as a discrete population.

Appendix 1. **Summary Table of Proposed Actions for San Joaquin Fall-Run Chinook Salmon, 1992 Through 1997**

1.	<u>Protection of Adult Salmon in Ocean and Inland Waters</u>	<u>Status</u>	<u>Agency</u>
a.	Evaluate unique marking of hatchery stock; selective harvest	N	S,F,L
b.	Propose zero harvest regulation to the Fish and Game Commission	N	S,P
c.	Evaluate "surrogate" protection in the PFMC Framework Plan	N	S,F,L
d.	Focus existing law enforcement effort on spawning migrations	U	S,F
e.	Pursue additional law enforcement funding/staffing	N	S,F
f.	Activate Fisheries Watch Networks	N	P
g.	Encourage greater reporting of violations through CalTip	N	S,F,L
h.	Increase public relations and education efforts	U,P	S,F,L
2.	<u>Upstream Migration Improvements</u>		
a.	Increase instream flows	U,P	S,F,L,P
b.	Maintain target temperature objective of 42-56°F	U,P	F,L
c.	Install and evaluate fall barrier in upper Old River	U	S,F
d.	Condition Port of Stockton dredging to avoid low dissolved oxygen	N	S,F
e.	Reschedule existing instream flows basin-wide	U	S,F,L
f.	Monitor/expand water hyacinth control program	U	S,L
g.	Install/evaluate migration barriers above Merced River confluence	U	S
h.	Trap and spawn adults if other measures fail	P	S
i.	Evaluate tri-annual amendments to the Basin 5C Water Quality Control Plan	N	S,F,L,P
3.	<u>Spawning, Egg Incubation, Emergence and Juvenile Salmon Protection</u>		
a.	Maintain acceptable water temperature in nursery and rearing reaches	P	F,L
b.	Increase instream flows	P	S,F,L,P
c.	Produce acceptable number of yearling salmon when hatchery programs are used	P	S
d.	Accelerate planning and construction of physical habitat improvements	U	S,F,L
e.	Reduce predation mortality	U,P	S,L,P

- | | | | |
|----|--|-----|---------|
| f. | Evaluate/encourage conjunctive benefits of domestic water supply projects | N | S,F,L |
| g. | Accelerate evaluations, construct and operate fish protective devices on priority diversions | P,N | S,F,L,P |
| h. | Accelerate planning studies for offstream storage development | U | S,F,L |
| i. | Continue planning/design of hatchery supplementation facilities | P | S |

4. Improve Smolt and Yearling Survival During Migration

- | | | | |
|----|--|-----|---------|
| a. | Increase instream flow in nursery tributaries | U,P | S,F,P,L |
| b. | Augment Vernalis Flows through basin-wide streamflow regulation in April/May | U | S,F |
| c. | Net positive San Joaquin River outflow in April/May | P,N | S,F |
| d. | Install, repair or upgrade fish screens on river diversions | P | S,F,L |
| e. | Evaluate use of alternative water supplies for riparians | N | F |
| f. | Maintain acceptable temperature conditions | P | S,F,L |
| g. | Evaluate/install/operate a complete barrier in Old River | U | S,F |
| h. | Use "salmon operating criteria" at SWP and CVP pumps, April and May | U | S,F |
| i. | Upgrade screens at SWP and CVP facilities | U | S,F |
| j. | Reduce predation losses at Clifton Court Forebay | U | S |
| k. | Reduce indirect mortality | P | S,F |
| l. | Evaluate other measures to protect juveniles and smolts | N | S,F,L |

5. Genetic Maintenance

- | | | | |
|----|--|---|-------|
| a. | Use cryogenic preservation of fall-run gametes | N | S,F,L |
| b. | Use selective harvest techniques (see 1.c.) | N | S,F |
| c. | Establish a captive breeding program | N | S,F,L |
| d. | Complete genetic differentiation studies | N | S,F,L |

Status: U = Construction/Operation underway
P = Planning underway
N = No activity

Agency: S = State
F = Federal
P = Private
L = Local (County and local districts)

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